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IT Service Management Intelligence Model to Support the Implementation of Electronic Government System (EGS) in Indonesia

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***Abstract*— Government institutions operate in a diverse environment that includes a wide range of issues such as social, economic, political, cultural, and other related issues. This fact eventually leads to various challenges and problems related to public services. The state of the existing resources and the management mechanisms affect the quality of services. These conditions require a comprehensive approach to the government's system. Electronic Government System (EGS) architecture is developed to provide guidelines in synchronizing and integrating applications employed by central or regional government agencies. The purpose of EGS service management is to guarantee sustainability and improve the quality of EGS Services to EGS users. The development of smart and holistic service applications can be a starting point in achieving a quality service system, including the government system, a system of service management that involves various elements holistically. This research aims to propose an Information Technology Services Management Intelligence model to support the implementation of EGS. This model approach is based on a holistic view of an environment in delivering public information technology services. It is also based on ITSM and Intelligent Systems, including architecture, alignment, and adaptability. The proposed model assists developers in defining conceptual needs of information technology services based on business perspectives to create intelligent systems that can dynamically predict and meet their needs.**

***Keywords*—Electronic government system; ITSM; model; intelligent systems.**

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I. Introduction

As service complexity in organizations continues to rise, information technology (IT) has shifted its focus from integration, and automation needs to developing smart abilities that can understand current and future needs. This can be achieved with a holistic perspective on the diversity of components of the organization that are interconnected and dynamic. To realize various programs and achieve their objectives, government institutions need an appropriate strategy and tactic. The government is required to come up with an intelligent solution that can create a sustainable environment that improves the management of various resources, infrastructures, environment, and other things related to public service needs [1].

The Indonesian government has made various efforts to overcome these problems, one of which is promoting bureaucratic changes through the Bureaucracy Reform program. This program is an attempt to fundamentally renew and change the system of governance, especially concerning institutional aspects, management, and human resources. The mission of this program is to create a professional, integrated, and high-performing government bureaucracy. Officially, this program began to be implemented in 2010 with the enactment of Presidential Regulation No. 81 of 2010 on the 2010-2025 Bureaucratic Reform Grand Design.

Prior to the enactment of Presidential decree 95/2018 on Electronic Government System (EGS), the government (Ministries, Institutions, and Local Government) had implemented EGS individually according to their respective capabilities and achieved a varying degree of EGS rate of progress. This individual enactment sets off the fabrication of Presidential decree 95/2018 to improve the integration and efficiency of electronic-based government systems, governance, and EGS management nationally. It is essentially new governance or government management era in Indonesia [2]. EGS provides opportunities to drive and realize open, participatory, innovative, and accountable governance, boost collaboration between government agencies in government affairs and tasks to achieve common goals and improve the quality and reach of public services. More importantly, it also optimistically aims to curb abuses of authority in the form of collusion, corruption, and nepotism by implementing an electronic-based community monitoring and complaint system [3].

Concerning the management of IT services, in Presidential decree 95/2018 section nine article 54, it is stated that EGS service management aims to guarantee sustainability and improve the quality of EGS Services to EGS Users. EGS User Services comprise services for complaints, disturbances, problems, requests, and changes regarding EGS Services from EGS Users [4].

Referring to the Indonesian government plan contained in "Making Indonesia 4.0" roadmap, Industrial Revolution 4.0 poses tremendous potential in revamping industry and changing various aspects of life. Industry 4.0 includes a variety of advanced technologies such as artificial intelligence (AI), the Internet of Things (IoT), wearables, sophisticated robotics, and 3D printing. Indonesia will focus on five main sectors for the initial adoption of this technology, namely (i) food and beverages, (ii) textiles and clothing, (iii) automotive, (iv) chemistry, and (v) electronics, as shown in Figure 1.

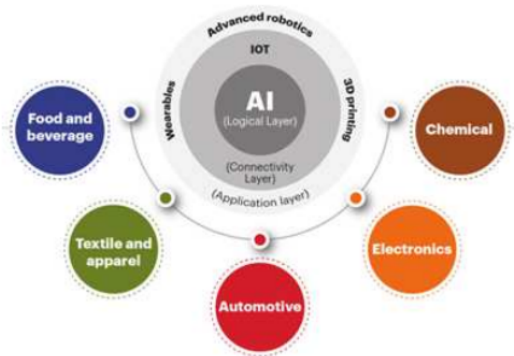

Fig. 1 Focuses of Industrial Revolution 4.0 Development in Indonesia [5]

IT infrastructure supports computerized business processes, which means it needs to be managed as a service. Therefore, to generate value for its customer to IT services [6], organizations need to implement IT Service Management (ITSM). IT service management is defined as a collection of frameworks that assist organizations in managing services. The use of these frameworks in the IT service provider domain is growing all the time [7]. Information technology service management (ITSM) has become the current management approach to the availability of IT services worldwide [8].

Service Management automation as a driver of IT industrialization has been a subject of great expectation and optimistic prediction [9]. Some of the benefits of the IT Service Management initiative perceived by the organization are customer satisfaction, staff satisfaction, service management culture, better process maturity/more standard process, improved tools and technology, improved service standard, improved service quality, improved efficiency/productivity, cost reduction, and better operational transparency [7]. ITSM frameworks can provide numerous organizational benefits when implemented in a planned and "conscious" manner [7], such as:

- Improved process control and documentation [11].
- Improvements in process metrics that can be measured [12]
- Enhancement of IT service quality, customer satisfaction has increased, IT costs are being reduced [11], [12]
- Increased efficiency/performance [8], [11], [12]
- Improved IT-business alignment [8], [11]
- Internal communication process efficiency [8], [12]
- Improvements in organizational competitiveness [13]
- Mature procedures [11].

The development of smart and holistic service applications can be a starting point in achieving a quality service system, including the government system, a system of service management that involves various elements holistically. Moreover, the availability of services can also continue to grow, and change based on the needs of the environment, both those involved directly or indirectly.

For this reason, public service applications based on the Intelligence IT Service Management approach need to be developed to meet those needs. The focus of the study proposed in this paper is the application development stage to create an IT service system that has value, which is service components developed based on an intelligent view of architecture, technology, and the context of current and future business processes.

II. Material And Method

Research study on ITSM Intelligence Model to Support the Implementation of Electronic Government System (EGS) is at least related to AI Utilization in ITSM, Machine Learning and ITSM, and Internet of Things and ITSM.

A. AI Utilization in ITSM

Artificial Intelligence (AI) is developing and widely used for advancement in a number of domains. However, several challenges remain that hinder their implementation in e-government applications - both for improving e-government systems and e-government-citizen interactions [14]. Artificial Intelligence (AI) offers an equivalent transformative potential for the augmentation and replacement potential of human tasks and activities during a type of industrial, intellectual, and social applications. IT and business leaders are constantly challenged to promote cost efficiency, boost productivity, and improve user experience. Accepting service management as the main enabler led many organizations to invest in the initiative to reform the tools that are currently being used [15].

Incorporating artificial intelligence into the ITSM domain enables service providers to use utility software to make assessments and decisions based on data and pattern recognition in data collected on various channels and systems. Moreover, AI also enables service providers to improve user experience and service in a meaningful way to the business and reposition the IT workforce from routine transactional tasks to innovative and creative ones [16]. How AI works in ITSM can be seen in Figure 2.

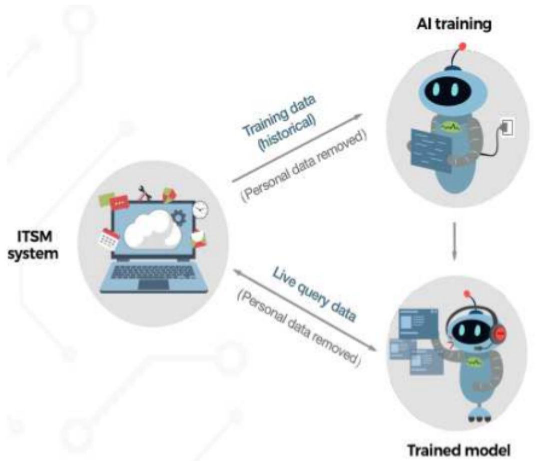

Fig. 2 How AI works in ITSM [17]

Public sector organizations like the government are interested in using intelligence capabilities to deliver policies and deliver efficiency in an environment of high uncertainty [18]. AI will be helpful in decision-making processes moreover as disaster prevention and response, can monitor environmental changes, enhance government-citizen interaction, individualize services, and interoperability [19]. Although few studies are conducted to improve e-government services, only a few addresses advances in AI in the automation of e-government services [20]. Hence, proximity is still needed to utilize sophisticated AI techniques and algorithms to address e-government challenges and needs [14].

The real benefits of AI will begin to manifest in IT service when it can perform human actions and actions humans prefer not to do. These actions may fall under one of three categories: smart automation, strategic insight, and predictive analytics. With the help of AI technology such as Machine Learning (ML), the service desk can create a categorization model based on IT service historical data. The ML model will also increase in accuracy over time by computing data in real-time. Such ML-based model is more efficient than manual categorization or rule-based automation [17]. Potential benefits of AI use in government [21] is efficiency and performance benefits [14], [22], [23], risk identification and monitoring benefits [24], [25], economic benefits [14], [22], data and information processing benefits [26], service benefits [24], [26], benefits for society at large [22], [25], [27], decision-making benefits [23]–[25], [28], engagement and inter-action benefits [23], [27], and sustainability benefits [24]. Incorporating AI into ITSM will revolutionize daily operations in the whole organization. Nevertheless, the implementation must be carefully planned and executed to ensure successful adoption throughout the organization.

B. *Machine learning and ITSM*

IT Service Management (ITSM) comprises numerous activities directed toward IT infrastructure upkeep. Thus, ITSM is considered important in any company, even in ones unrelated to IT. Incident time resolution is a key performance indicator for ITSM [29]. An important area of significance in artificial intelligence is the progress that has been made in machine learning. Machine learning focuses on giving computer systems large amounts of data and information to help computers learn, act, and think like humans independently. Machine learning is an integral part of developing IT services and ITSM devices. In comparison, the traditional application relies on business processes and requirements to generate specific and predictable results [16]. IT Service Management Automation using machine learning of various processes in IT Service Management used by Engineers to report IT problems in organization.

Machine learning is the ability of systems to learn from data collected without being explicitly programmed. Machine learning typically uses sophisticated statistical techniques and computing systems to improve ITSM tasks over time. With machine learning, applications can write additional programs to interpret inputs and predict results. Advancement in machine learning is the spark that triggers the explosion of artificial intelligence [16]. Implementing the machine learning model in ITSM engenders significant improvement in user experience, efficient problem solving, reduction in service agent effort, service cost [29], and ensuring customer satisfaction [30].

From an ITSM perspective, machine learning is the ability of IT services and service management tools to learn from the data collected. From a value stream perspective, organizations define the activities, workflows, controls, and procedures needed to achieve business goals and learn and create new things or improve existing results with or without human intervention that is subject to all its limitations.

C. *Internet of Things and ITSM*

The Internet of Things (IoT) has become an important networking paradigm, and there are many smart devices connected to IoT. IoT systems generate big data, and thus more IoT applications and services are emerging [31]. Internet of Things is a system that enables common devices to collect and share data over a network. The data collected is relayed to consumers and producers or service providers using an application embedded in the device. From an ITSM perspective, smartphones, tablets, and another end-user devices can be used to collect data on end-to-end customer experience. Data is hugely influential in improving IT services and harmonizing those services to create a better value flow. Service management organizations must design IT services that provide high availability but can utilize data collected from smart devices to identify the maintenance needed, proactively identify and eliminate problems, and automate general requests [16].

When the Internet of Things (IoT) changes the world around us, it also generates new opportunities in Service Management. Through this, the most critical aspects of a business, People, Assets (Tools), Systems, and Processes, are interconnected in countless ways. Smart Devices, together with ITSM systems, can diminish, or even eliminate, the need for human intervention with automatic warnings, diagnostics, and abilities to run standard procedure capacity. Connected devices that are constantly active and available will allow IT systems to make automated decisions based on data in real-time. Automated decision-making allows IT teams to focus on more urgent matters, ultimately leading to cost reduction [32].

IT Service Management functions have become an integral part of digital transformation. Increased reliance on technology calls for a smarter approach to technology provision and management [33]. Service management is a crucial consider maintaining service-enabled solutions in a very dynamic and extremely scalable IoT system and deals with many problems [34] regarding service provision [35], [36], orchestration [37], [38], composition [39]–[44] and adaptation [45]. Table I shows some of the challenges related to service management in the context of IoT.

TABLE I
CHALLENGES RELATED TO SERVICE MANAGEMENT IN THE CONTEXT OF IOT

Challenges	Types	Paper
Interoperability	Connectivity	[46]
	Semantic	[47]
	Syntactic	[34]
Scalability	Vertical	[34]
	Horizontal	[48]
Security	Identity Management	[49]
	Authentication and Authorization	[50]
	Vulnerability Detection	[34]
	Availability	[34]
Big Data	Accuracy	[51]
	Real-time Analytics	[51], [52]
	Visualization	[51]

D. Research Method

The schematic/diagram process of the research method/step system can be seen in Figure 3.

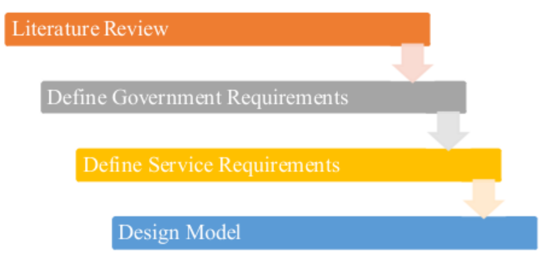

Fig. 3 Research Method

1) Literature Review: Conduct theoretical exploration, survey of current IT service approaches, and identify the state-of-the-art research domains and fundamental issues that must be resolved.

2) Define Government Requirements: Explore the government's needs related to service management and identify the current ITSM process to get a business perspective.

3) Define Service Requirements: Identification of services in government which are electronic-based public services and government administration support services.

4) Design Model: The construction of the model began with the provision of a description based on the adaptive requirements model view.

III. RESULTS AND DISCUSSION

The government has been striving for fast and efficient government management by implementing Electronic Government System. However, in its implementation, many applications developed by government agencies (K/L/D/I) overlap with other existing applications, whether mandatory ones or internally managed ones. Moreover, many developed applications are not relevant with the definite objective of providing public services.

EGS architecture is developed to provide guidelines in synchronizing and integrating applications employed by central and regional government agencies. In principle, EGS architecture is the key framework that describes the integration of multiple domains, namely:

- Business Process Architecture.
- Data and Information Architecture.
- EGS Infrastructure Architecture.
- EGS Application Architecture.
- EGS Security Architecture.
- EGS Service Architecture.

However, these EGS architectures can be developed with technology such as IoT, Big Data Analytics, and Artificial Intelligence (AI). Internet of Things has tremendous potential to create highly valuable public services. The crux of the matter is how the government and public organizations can adapt traditional structures and processes into the innovative field of IoT to produce public value [53]. Because of this, EGS services are expected to be adaptive and responsive to the service customization needs required by the user so that the expected value can emanate and be directly perceived by people as the user. One way is to broaden the availability of EGS Service channels that IoT-based devices can access.

The concept of Big Data Analytics (BDA) is related to the accumulation, integration, analysis, and utilization of large-scale data for various purposes. BDA enables organizations in both the private and public sectors to make better decisions (e.g., faster and more efficient) based on evidence and insight [54], [55]. By leveraging this technology, EGS services are expected to support decisions and policymaking for the government, business actors, and the community.

Artificial Intelligence (AI) is a technology that simulates human intelligence in machines, complete with cognitive function to learn and solve problems as humans do. AI can be utilized as an innovative approach to improving communication between people and the government. The government and citizens communicate through different channels, including social media platforms, email, documents, or chatbots. All these channels generate unstructured data written in natural language. The use of AI in EGS can help the government reduce administrative burdens such as answering questions, filling documents, looking for documents, and translating sounds/writings. In terms of public service, technology should be considered in developing EGS architecture. In the current EGS architecture, AI can be introduced to IT services in which technology such as Machine Learning, NLP, and Virtual Support Agent are contained, which in principle leverage IoT, BDA, and AI technology.

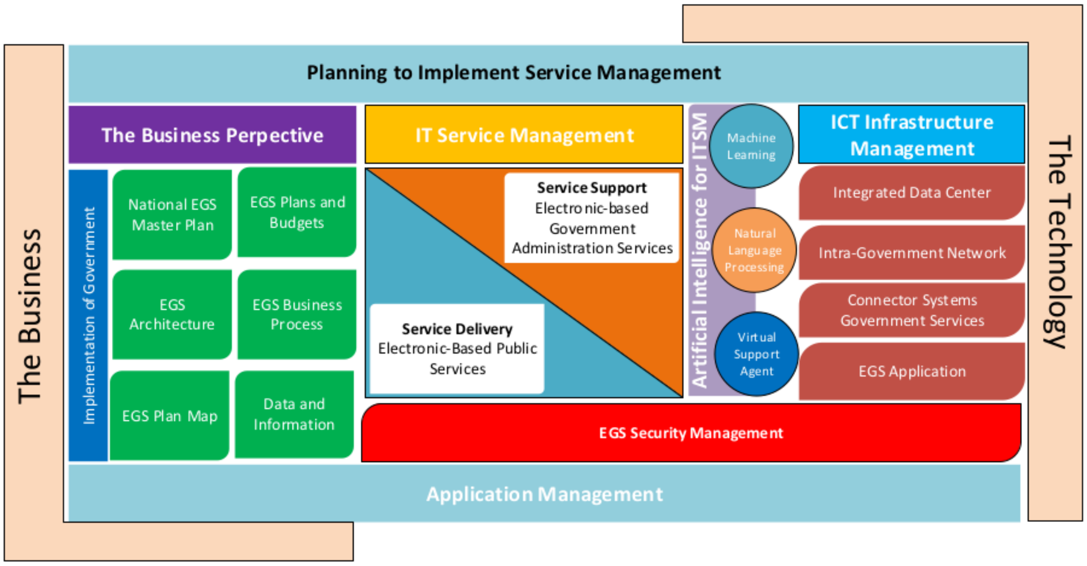

Fig. 4 ITSM Intelligence Model to Support the Implementation of EGS

The construction of the model in Figure 4 began with the provision of a description based on the adaptive requirements model view. In the previous study, we have defined three requirements views for the cloud computing adaptive model in the IoT environment: view-architecture, view-alignments, and view adaptivity. In the present study, these three views are expanded to define the needs of the Figure 4 model as presented in Table II. The first view is the architectural dimension view, an understanding of the EGS environment that must be defined. In this view, it is recommended to adopt one of several existing enterprise architecture frameworks (EA). However, the adoption should consider its ability to fulfill the functions and technologies of AI, Big Data, and IoT. For example, several EA frameworks can be classified into hybrid enterprise architecture with characteristics oriented to development processes. Thus, in practice, they can be expanded by considering the suitability of the characteristics of the EGS.

TABLE II
EGS REQUIREMENTS DESCRIPTIONS

View	Model	Description
View-architecture	• Business Process Architecture: EGS strategy and process. • Data and Information Architecture: EGS data entity. • Infrastructure Architecture: EGS technology infrastructure. • Application Architecture: EGS application candidates. • Security Architecture: EGS security system. • Service Architecture: EGS service model.	• Service system root may be deemed as a representation of business strategy goals and stakeholder plans. • Business strategies are decomposed into several architecture representing organizational functions, so that plans for operational data and information, infrastructure, application, security, and EGS service technology can be identified.
View-alignments	• Role and Actor Catalog: business service, human actor, computer actor. • Data component catalog: separated database, separated schema, shared scheme. • Application Portfolio Catalog: primary modules, extension modules. • Environmental Technology Catalog: platform decomposition, security system.	• Every functional system is connected to service items and components, so that the need for role and actor catalog, data catalog, application catalog and the integration of IoT infrastructure and technology can identified. • Service quality assurance is a constraint of service quality related to reliability, availability, security, etc. It is a benchmark for view-alignment in determining IT service and view-adaptivity as the need for smart systems.
View-adaptivity	• Service Catalog: business service, technical service. • Service Level: service level agreements (SLA).	• Monitoring is performed for all functional services (service catalog) which have been harmonized into an IoT environment. • Adaptation mechanism refers to every service quality assurance composed into an SLA.

Furthermore, resulting artifacts from the architecture view are harmonized with the IoT environment, as view alignments on EGS characteristics. In the second view, it is important to consider the integration and standardization of each component involved in the concept to expand the benefits of internet connectivity that can continuously connect a variety of real-world objects as physical and virtual representations. The result of dimension mapping can meet the criteria of the IoT service model, that is, a service that is able to provide data in real-time collected from various spheres, thereby representing fast-growing real-world objects physically and virtually.

Based on the theory of intelligent systems, problem-solving should consist of an initial state, a set of operators, and state targets. A set of initial states and state targets is a set of states, while a different set of these states and operators is knowledge. Knowledge management born from these view-architecture and view alignments can be represented through scans and senses on changes and adjustments between contexts (enterprise-level) and rationalization (service level). Our previous paper [56], [57] has defined primitives for such pattern needs through monitors, analyzers, planners, executors, and knowledge (MAPE-K) model. More details on how a system can carry out adaptation patterns of MAPE-K based on contextual requirements can be perused in our paper [58]. The model was defined generically for various software system requirements in our previous work. For EGS requirements, the model can be directed for the following two levels:

- Enterprise level context that is related to business process architecture, data and information architecture, infrastructure architecture, application architecture, security architecture, and service architecture based on EGS basic framework.
- Service level context is the representation of IoT environment requirements.

Once those two levels are mapped against view-architecture and view alignments, a key view to building a smart EGS is needed, that is, view-adaptivity. This view represents the MAPE-K model that can monitor, analyze, plan and perform adaptation activities between view-architecture and view alignments, so that service strategies can have the capability to understand current and future needs. The recommended implementation of MAPE-K model for EGS is to expand upon our previous work [56], [57], [59], which is by implementing Machine Learning and determining the most optimal approach based on developed primitives.

All components in view architecture and view-alignments can be classified as service catalog and service level in view-adaptivity. Service catalog consists of business service and technical service, while quality assurance related to the provision and delivery of IT services is represented as service level agreements (SLA) at the service level. An IoT environment, without a doubt, will involve various complex technology and face all sorts of issues, such as system failure, hardware, and software failure, changes in components, workload, external conditions and so on, leading to a failure when users interact with the system during service performance.

In our proposed model, problems in user interaction can be squashed with the implementation of Natural Language Processing to automate IT service user requests. As a result, all kinds of users can communicate through different channels such as social media platform, email, documents, chatbots, and so on. In addition, Virtual Support Agent may be employed as an approach to construct view-adaptivity since the MAPE-K model recommended in our previous work has been developed based on the agent approach. The expansion of this model can potentially provide enormous benefits for IT services because service desk agents can perform various transactional tasks, customer service, and other processes based on the categorization of historical service data. Furthermore, it can also function as a support for decision-making through recommendations of smart virtual agents.

IV. Conclusion

This paper proposed an ITSM intelligence model to support implementing an electronic government system (EGS). The proposed model was constructed based on integrating the Intelligent Systems approach into Information Technology Service Management. Three requirements' views were formulated as primitive models: view-architecture, view-alignments, and view-adaptivity. The model provides conceptual guidelines for developers in delivering a smart service system that can understand current and future system requirements. The model in this paper was positioned as a preliminary study to build starting fundamentals for defining more complex technical components. As for future endeavors, we plan to apply this model to real case studies in government institutions and conduct an empirical evaluation to test the validity of our proposed model.

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